



INNOVATIVE PRACTICES OF TEACHING AND LEARNING OF MATHEMATICS INTEGRATED WITH ART

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ABSTRACT

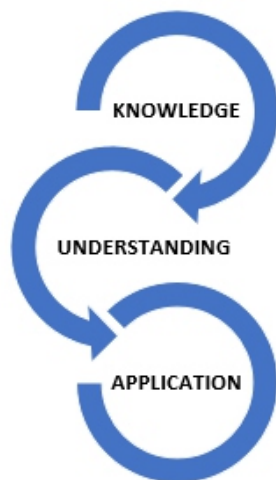
Mathematics & Art are dealt by two opposite sides of the human brain. This paper focusses on the impact of integration between the two domains to concentrate on the overall development of a human brain at the most adaptable stage i.e., 0-17 years. Any teaching strategy aims at progressing towards unwinding the working of universe and enabling the individuals to build a better future for themselves as well as the humanity as a whole. This paper looks at various strategies that aid the learning of Mathematics with the help of Arts segregated on the basis of major areas of the curriculum: Foundation, Statistics, Geometry, Algebra, Application/logical development and Calculus. Every practice suggested in the paper shall focus on reducing the gap between the curriculum and real-life for the students. This integration of teaching and learning of Mathematics through art has been existing from centuries and can be reinstated to the modern day Applied Mathematics through the support of traditional practices with the modern-day developments.

KEYWORDS: Mathematics, Art, Integration, Betterment of Mankind

INTRODUCTION

The aim of study of Mathematics is to unfurl the working of the universe (like Physics) as well as equip the humanity with well-developed individuals to design optimum methods of living. Since Mathematics involve in-depth analysis and branches out to touch abstract as well as applied side of study, there is often a gap between the understanding and the application.

This is where the role of an educator begins: bridging the gap between the study and application through understanding thus completing the cycle. To facilitate the process of understanding an educator may need to adopt varied strategies thereby exposing the students to a new experience of learning.



This paper highlights the role of ART in this process of transfer of knowledge to application through understanding. The target here being inclusion of ART education in facilitating the understanding. The process of humans' efforts to change and improve their lives with a conscious motive is called art education. The process of humans' efforts to change and improve their lives with a conscious motive is called art education. The larger definition of "the arts" has been considered here including everything from painting to theatre, song, design etc. The process of humans' efforts to change and improve their lives with a conscious motive is called art education. This motive coincides with the purpose of Mathematics.

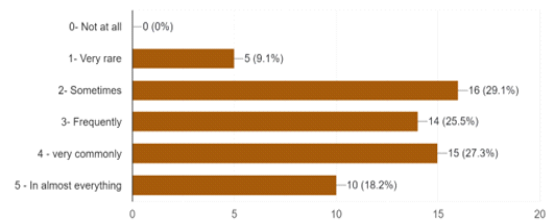
METHODOLOGY & PRACTICES

The integration revolves around the impact of Art and Mathematics for a student, so it becomes more important to understand and analyse student's point of view.

A survey was conducted amongst the school students of three different schools. Following are the results of this quick survey:

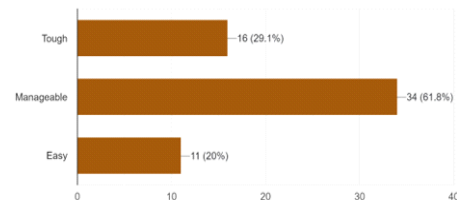
On a scale of 0-5, How closely are you able to see the application of what you study in Mathematics in real-life?

55 responses



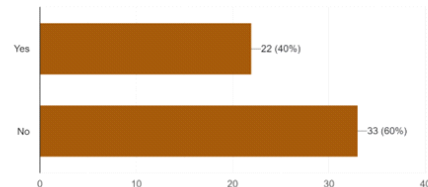
How do you categorize Mathematics?

55 responses



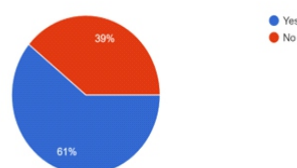
Have you ever used any ART form (Dance, Music, theatre, painting or sculpture) in your Mathematics class?

55 responses



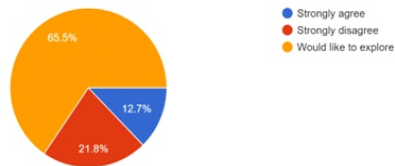
If Yes, was it effective? do you still remember that concept with clarity?

41 responses



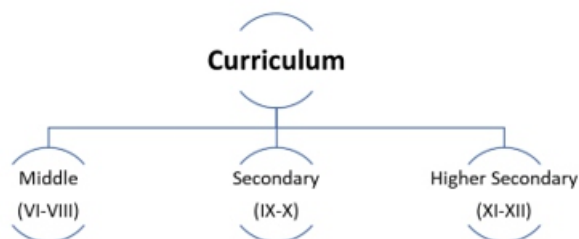
Do you agree with the following statement: "Mathematics cannot be combined with the ARTS as these two look completely different."

55 responses

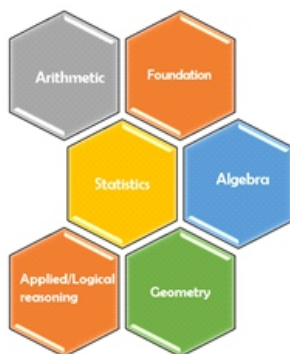


- Most of the students could experience the presence of Mathematics in real life situations
- Majority of students are yet to explore the integration of the two subjects
- Around 60% students denied experience learning through Art in Mathematics
- Even if it exists, it seems limited and not fully utilised
- The results do not necessarily point towards lack of effectiveness but rather lack of variety and techniques
- This highlights the need of **development of new techniques and inclusion of Art education in Mathematics more frequently**

To resolve this problem, the paper has been divided into three sections: Middle School, Secondary classes and Senior Secondary classes.



Further the practices have been designed as per the branch of Mathematics involved:



1. Middle School (Classes VI-VIII)

- Foundation – Includes Number system starting from Natural numbers to Rational numbers. May also include Ratio and Proportion for younger classes while Exponents can be the foundation for the upper classes.

Suggested Practices

Colour stripe:

- Start by colouring every second number to mark out even ones
- A second stripe can then be applied to the box of every third number starting from 1
- Third stripe to every fourth number and so on up to 9
- Some numbers will have a single stripe in colour or uncoloured- these are the prime numbers; number of colours in boxes will also suggest number of factors (See the figure below)

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

- Geometry – Starts with understanding of elementary shapes and goes up to visualization of Solid shapes like tetrahedron.

Suggested Practices

Buddha's snails:

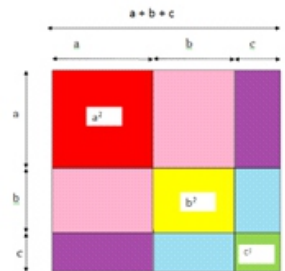
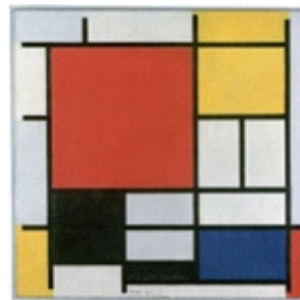
The number of snails on Lord Buddha's head is 108.

It is not an ordinary number: $108 = \text{sun's distance/sun's diameter or Moon's distance/Moon's diameter}$.

Students can make 108 paper/clay snails and be asked to arrange these 108 clay/paper snails to cover the head of a statue

Target concepts shall be Ratio and Proportion (to decide the size of snail) as well as Geometry as it targets at formation of pyramids.

- Algebra- Starting from basic algebra to identities involving multiple variables Image on the left is Mondrian art while right side represents the representation of the identity $(a+b+c)^2$.



Clearly, the identity can be seen as an example of Mondrian art. Instead of starting with geometric representation, start with Mondrian art and take the students to that concept.

Wassily art:

The Art teachers can teach students Wassily art while the mathematics teacher shall help them with the angles and curves.

This will create a masterpiece like Wassily and induce ample knowledge of Geometrical shapes, angles, curve etc.

2. Secondary (Classes IX-X)

Suggested Practices

Sequences:

Tap Sequence:

- Students shall prepare a tap dance with taps changing as an Arithmetic progression
- Other teams shall guess the sequence from the tap

Initially the students might not be able to choreograph many such sequences but with repeated practice and proper help from the dance teacher, students will be able to design such sequences.

Buddha's snails:

Lord Buddha's example above can be extended to sequences if the students use a pattern or a sequence to set these clay/paper snails.

Students are often asked to make a maths song/rap etc. But what we end up getting is some lyrics with mathematical concept and music in background.

This is not what we look for when we say Integrate Music and Mathematics.

Try the below activity when it comes to Mathematics and Art:

Design your musical instrument:

Create Ghungroos with bells at varied distance and check the difference in sound,

Now, relate it with the Arithmetic Progression with common distance being the distance between the two rows of bells

or

Number of ghungroos in each row can represent an (nth term of an AP) with d being difference of ghungroos from the previous row.

Let the students be inventors.

- Algebra

Surrealism is a cultural movement that developed in Europe in the aftermath of World War I in which artists depicted unnerving, illogical scenes and developed techniques to allow the unconscious mind to express itself.

Can this be imagined as a linear equation?

Example: In the picture below, let the sensory organs (eyes, nose and lips) be the constants while number of fingers visible be the variables.

Example in below equation of the left side

$3x+5$ and equation on the right $3x+1$.



Thus, a linear equation in one or more variables can be expressed as a drawing.



Can you imagine this being drawn on a cartesian plane?

Well, the next technique is straight line art out of linear equations.

Linear art:

The students shall form this kind of art using linear equations in two variables on a cartesian plane.

Let the sketch artists of your class shine at Mathematics too.

RESULTS AND CONCLUSION

The research is incomplete without proper understanding of Challenges.

Following challenges need to be kept in mind:

- **End to End Understanding:** Properly designed activity clearly indicating aim to concept with well-coordinated period planning between art and Mathematics teachers is necessary to enable effective integration between the two areas
- **Implementation:** Proper knowledge of the art form and proper explanation of the Mathematical concept should be provided to the students. Half-knowledge or improper instructions may lead to confusion and a wastage of time.
- **Time Management:** These activities may require additional time for in-depth understanding of the concept. Also, different students may require different support to complete these activities. But the time spent must be viewed as an investment, keeping in mind the goal at hand
- **Lack of Materials:** Proper arrangement and availability of materials for the activities can be a challenge till the time students build an interest towards the activity.
- **Financial aid:** Some schools/Students may require additional financial support to incorporate such practices
- **Proper language:** For delivery of concepts by both Art and Mathematics teacher, clearly specifying technical terms is necessary. This falls under proper implementation of each activity
- **Awareness about interests of the students:** Inclination of different students towards different art forms can be a hindrance, but the classroom can be divided into groups on the basis of interest
- **Traditional Mindset:** As the Survey suggested, Students have a hard knitted mindset about Mathematics and Art being absolutely different. The integration may require time and patience of the teachers

In Conclusion, there is no end to what can be brought into the classroom. A teacher can build a mathematical artist while teaching. As a teacher I believe the more the brain engages in the classroom, the better the child develops.

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